Perpendicular Vectors

$$\boldsymbol{v} = \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix} \qquad \boldsymbol{w} = \begin{pmatrix} w_1 \\ w_2 \\ w_3 \end{pmatrix}$$

Scalar product

$$\boldsymbol{v} \cdot \boldsymbol{w} = \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix} \cdot \begin{pmatrix} w_1 \\ w_2 \\ w_3 \end{pmatrix} = v_1 \cdot w_1 + v_2 \cdot w_2 + v_3 \cdot w_3$$

Angle between 2 vectors ***v*** and ***w***

$$\boldsymbol{cos\theta} = \frac{\boldsymbol{v} \cdot \boldsymbol{w}}{|\boldsymbol{v}||\boldsymbol{w}|}$$

When 2 vectors are perpendicular, then angle between them is 90°

$$\boldsymbol{cos90°} = \frac{\boldsymbol{v} \cdot \boldsymbol{w}}{|\boldsymbol{v}||\boldsymbol{w}|}$$

$$\boldsymbol{0} = \frac{\boldsymbol{v} \cdot \boldsymbol{w}}{|\boldsymbol{v}||\boldsymbol{w}|}$$

$$\boldsymbol{0} = \boldsymbol{v} \cdot \boldsymbol{w}$$

When 2 vectors $\boldsymbol{v}$ and $\boldsymbol{w}$ are perpendicular then $\boldsymbol{v} \cdot \boldsymbol{w} = 0$

Find ***a*** if the following two vectors are perpendicular

$2\boldsymbol{i} - 4\boldsymbol{j} + a\boldsymbol{k} \qquad a\boldsymbol{i} + \sqrt{3}\boldsymbol{j} - \boldsymbol{k}$

$$\begin{pmatrix} 2 \\ -4 \\ a \end{pmatrix} \cdot \begin{pmatrix} a \\ \sqrt{3} \\ -1 \end{pmatrix} = 0$$

$2 \cdot a + (-4) \cdot \sqrt{3} + a \cdot (-1) = 0$

$$a - 4\sqrt{3} = 0$$

$$a = 4\sqrt{3}$$